EVIDENCE SUGGESTIVE OF THE OCCURRENCE OF 'INDIVIDUAL DICHROMATISM' IN *MEGASCOPS ASIO.*

BY ARTHUR P. CHADBOURNE, M. D.

Plate I.

(*Concluded from Vol. XIII, p.* 325.)

As to the cause of the altered color:— The exclusive diet of liver seems to be the only unusual feature in the conditions under which my two Owls lived, compared with other birds of prey in captivity; or at least, it is the most noticeable one. We have already seen that the change in the female was first apparent after this food had been alone used for about three weeks, and also that the smaller Owl a little later showed signs of a similar change; while almost an equal length of time after the liver had been discontinued, there seemed to be a gradual loss of the red tint. Was this chance, or is it a hint, as to the cause of the red brown color? The liver is well-known to contain an extremely large amount of coloring matter, and to play an important part in the production of the majority of the different pigments of the organism, either directly or indirectly. Moreover, it is a fact that the color of the plumage can be altered by certain kinds of food — thus, some breeds of the Canary (the 'Yellow Norwich' among others), change from a pure yellow to a bright orange, if red pepper is daily mixed with their food; and this too without any feather loss, as I have myself seen. Who can tell the effect of a continued diet of liver, until he has tried the experiment — on an Owl?

The way in which the colors of feathers are produced can only be briefly mentioned here, but a few words on the subject may not be out of place. In general, feather-color is due (1) to pigmented matter of one, or of several colors; (2) to the physical effect of the structure of the part on the light rays; or (3) to both of the above combined. Pigment absorbs all kinds of light except that on which its color depends, thus in a brown feather the only unabsorbed light rays are those which produce the sensation of brown, and these alone reach the eye. Black results from the complete absorption, or deflection of all light rays; while if none

of the spectral colors fail to reach the eye, the combination produces white. In addition, an almost endless variety of colors, shades and tints are caused by mixtures of different 'pigments,' much in the way we use different paints. The action of the structure and form of the colored parts is, on the other hand, purely physical; for example, the lateral branches, forming the vane, may have their surfaces so shaped, as to produce the effect of a multitude of small prisms, by which the different colored rays are made to diverge, only those of a certain color reaching the eye; perhaps, as believed by Gadow, slight movements bring different kinds of rays successively to the eye, and iridescence is the result.

Color-change in the individual feather, — or, in a broader sense, in the plumage as a whole, without adequate new feather-growth (*i. e.*, without a so-called 'moult'),[1] seems to have received little or no attention from ornithologists in this country during the past quarter of a century or more.[2] Yet about 1850, when the theory of "color-change without moult" was revived by Schlegel and Martin independently, German ornithological literature teemed with articles on this subject; and it had been proved even prior to this that the plumage might be completely altered in color without feather-loss or new feather-growth. And such color-change also seems to be normal, and probably recurs at regular intervals in certain individuals and conditions among various species. It has been shown in connection with the subject of the 'Spring Plumage of the Bobolink,'[3] that feather-change and color-change are two distinct processes; but the point which concerns us at present is that *a change in the color of the feather, or even of the whole plumage, not only may, but has been proved to occur normally without increase of feather-loss.*

The color of my Owls was evidently due to pigmented matter, and was practically independent of the physical action of the structure of the part on the light rays. Morphologically, one

[1] The 'aptosochromatism' of Coues (*Cf.* Auk).

[2] The above was written in 1894, before the recent articles of Allen, Chapman, Stone and others had appeared.

[3] 'The Spring Plumage of the Bobolink.' Auk, Vol. XIV, pp. —. [The publication of this paper is necessarily deferred till the April number.— EDD.]

black, and at least two varieties of brownish coloring matter (so-called 'pigments'), were present, not only after the red-brown shade appeared in the plumage, but also in every feather of the gray type, except three of the 'first' and one from the mature gray plumage.

The *black pigmented matter* was made up of oblong-oval or elliptical granules, never of small rods, as in the domestic pigeon; but it is well-known that the shape varies in different kinds of birds. The amount of black granular matter was always relatively small, and it was chiefly confined to the deeper cell layers. Isolated spots of true black were frequent in the central cells, while around them there was often much dark brown.

The *brown pigmented material* was found in the form of a pale, nongranular, diffused stain, extending through all kinds of feather tissue; and also as brown granules, of various tints and sizes, which were usually in narrow lines or groups, instead of being generally distributed, like the nongranular stain. The two extremes were connected by a complete series of intermediate forms, showing every gradation between the dark chocolate and the ochraceous tint; while the size of the granules also varied considerably, and it was at times not easy to distinguish the homogeneous from the very finely granular. The black and very dark brown granules perhaps also intergrade, but on this point I cannot speak with certainty.

As the red phase developed, more and more red-brown granules and diffuse stain *seemed* to be present in the feathers, at times obscuring, or completely hiding the dark markings beneath (Plate I, fig. 1), or grouped and scattered about the black in the deeper layers, caused various shades and tints of brown and tawny. As a rule the seemingly black color proved to be the result of either a dense mass of dark brown granules, of the greater thickness of the darker portion of the specimen, or of both continued, plus an underlying area of true black in the deep tissues. The pure rufous and bright tawny portions had the coloring matter chiefly in the more superficial cell layers, and either little or no true black beneath; while the streaks and lines of brownish granules suggested the 'bast-fibre layer' of certain plants, and the tawny effect was heightened by the diffuse nongranular stain (Plate I, fig. 4, *b*

and *c*, fig. 5, and cut in text). In the white parts of the vane, the only color was a pale straw-yellow almost entirely limited to the outer (peripheral) cellular tissue, and probably caused by the

Two Barbs from near A., pl. I, fig. 1. Groups of dark colored cells are seen in some parts of the barbs. (Zeiss 16mm. apochromat. and No. 6 comp. oc.)

homogeneous stain (Plate I, fig. 1). The downy parts of the contour feathers had nodular enlargements at regular intervals, in which the coloring matter was usually collected (Plate I, fig. 4, *d*); in other specimens the nodes were almost colorless, and the internodes pigmented (Plate I, fig. 4, *a*). There seems to have been an absolute loss of black, as well as of the darkest brown granules

during the progress of the change to the reddish phase, for markings were absent, not merely hidden by overlying color, which had been distinct in corresponding specimens of the gray phase.

Feathers from twenty-five specimens of *Megascops asio*[1] in the writer's collection, in all stages of plumage, were indistinguishable from those of the dichromatic female in corresponding dress, both the black and also the various shades of brownish pigmented matter being present in the large majority of specimens examined; but differing in relative amount and distribution.

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[1] The material examined was as follows:

CAST-OFF FEATHERS FROM MY TWO OWLS.

First plumage	15 feathers.
Typical gray phase	9 "
Intermediate	56 "
During most marked stage of red-brown	10 "
Specimens from female after death of male	3 "
From skin of female	127 "
Total	220 "

CAST-OFF FEATHERS FROM SKINS OF M. ASIO.

2 specimens	first plumage, typical gray	91 feathers
1 "	" " " red	17 "
7 "	adult " " gray	114 "
9 "	" " intermediate	102 "
4 "	" " typical red	59 "
23 specimens		383 feathers

	Typical gray.	Intermediate.	Typical red.	Total.
Red-brown pigm'ntd matter present	206=(95%)	148=(100%)	226=(100%)	580=(98%)
Red-brown absent	13=(5%)	0=(9%)	0=(0%)	13=(2%)
Total feathers examined.	219=(36+%)	148=(25%)	226=(38%)	593

In short, so far as shown by the present material and methods of examination, *the dichromatism of Megascops asio, both in the species and also in the individual, is a quantitative difference in the distribution and relative amounts of the same morphological varieties of pigmented matter; and there is probably also an absolute, as well as a relative difference in the amount of coloring material in the various phases.*

Of the chemical and other relations between the pigmented matter, I shall say but little now. The usual qualitative tests and also the methods used by Krukenberg show that 'zoörubin' (Krukenberg), and 'zoömelanin' were present in almost all the feathers. No other coloring matter was detected chemically; but differential staining brought out marked differences in the affinity of the various brown granules for certain dyes, and also in the color-reactions of the black and brown granules. The microspectroscope gave spectra agreeing with Krukenberg's outlines for 'zoörubin.'

That the pigmented matter represents successive steps in a process of retrograde or destructive metamorphosis, seems not unlikely. The subject offers an attractive field for speculation, but one upon which we will not enter at present.

In conclusion, my two pets have, I think, fully proved (1) *that a change from the gray to the red phase of plumage did, in this case, actually take place in the same Screech Owl* (*M. asio*); (2) *that the change in question was not accompanied by increased feather-loss or new feather-growth* (*i. e., no 'moulting' occurred*); (3) *that, so far as known the double phase was in no way due to age, sex or season;* (4) *and that almost beyond question it was an instance of true 'individual dichromatism.'*

Explanation of Plate.

Figure 1. Feather from skin of 'dichromatic' female *Megascops asio* (coll. A. P. C. No. 4396), showing the colors and parts illustrated in the following figures. Slightly enlarged. Drawn and colored from nature by W. H. Kaula.

Figure 2, Barb from white portion of feather near B fig. 1. (Zeiss 4mm. apochromat. obj. and No. 4 comp. ocular. Mounted dry.)

Figure 3. Transverse section through barb from near D fig. 1. Shows distribution of pigmented matter in the deep and superficial cells. (Zeiss apochromat. obj. and No. 4 comp. oc.—Celloidin and balsam.)

Figure 4. Variations in the barbules of the same feather.
A, from near fig. 1 E. — Pigmented matter chiefly in internodes.
B, from near fig. 1 F. — No true black coloring matter present.
C, from near fig. 1 G. — Shows 'bast-fibre' arrangement of brown granules.
D, from near fig. 1 H. — Pigmented material almost lacking in internodes. (Zeiss 4mm. apochromat. obj. and comp. ocular No. 4. — Feather mounted dry.)

Fig. 5. A barbule much like that shown in C fig. 3, but more magnified. (Zeiss 4mm. apochromat obj. and No. 6 comp. ocular. Mounted dry.)

ZAMELODIA AGAINST HABIA.

BY DR. ELLIOTT COUES.

IN creating the new generic name *Zamelodia* I said (Bull. Nutt. Orn. Club, V, 1880, p. 98): "The genus *Hedymeles*, Cab., 1851, was based upon this species [*i. e.*, *Goniaphœa ludoviciana*], but cannot be used for it because of *Hedymela*, Sundev. (Öfv. Vet Akad. 1846, 223) for another genus of birds, the difference being merely dialectic. Cabanis seems to have proposed it simply because 'Habia Reich. 1850' was not classically correct. But *Habia* or *Abia* is said to be antedated by *Habia*, Lesson, 1831, and therefore untenable."

In an article entitled '*Habia* against *Zamelodia*,' Dr. L. Stejneger said (Auk, Oct. 1884, p. 366): "It is Agassiz (Nomcl. Zool., Aves, p. 34 (1843)) who first quotes 'Habia *Less.* Tr. d' Ornith. 1831,' — afterwards (Index Univers., p. 1 (1846)) 'correcting' it into *Abia;* but an inspection of Lesson's 'Traité,' etc., will show that *Habia*, as used by him, is only the French vernacular name applied to the birds of the genus *Saltator* Vieill., and Agassiz might just as well have cited 'Habia *Vieill.*, Analyse, 1816,' for that is the place where Vieillot himself applies the name as the vernacular equivalent of the systematic name *Saltator* proposed simultaneously."

My duly appreciated critic then proceeded to prove "that *Habia* was not used by Lesson or Vieillot as a systematic generic